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NASA TECH BRIEF

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Three-Phase DC Motor Decoder

A new three-phase, full-wave dc motor decoding circuit has been developed to simplify dc motor commutation. The circuit minimizes the components required to provide six properly-timed drive signals from three equal-interval sensor inputs (Figure 1).

The circuit shown in Figure 2 includes 12 transistors. The first six, Q_1 through Q_6, are used in decoding binary input signals produced by three angular position sensors connected to the dc motor. These input signals are fed into junction points of the delta-configured resistor network. The other six transistors, Q_7 through Q_{12}, form a power-switching bridge connected to the motor windings.

As the motor rotates, a potential gradient appears across different pairs of terminals of the resistor network for every 120° rotation. The gradient reverses direction every cycle. Transistors Q_1 through Q_6 conduct alternately at the start of every 60° interval. Each transistor stays on for 120°. Thus in a 360° cycle, all six transistors have turned on in the prescribed sequence.

Each of the decoder transistors is connected to one of the transistors in the bridge network. The bridge network is connected to a dc power supply. For each decoder transistor that is on, a corresponding bridge network transistor conducts, supplying power to the appropriate motor winding.

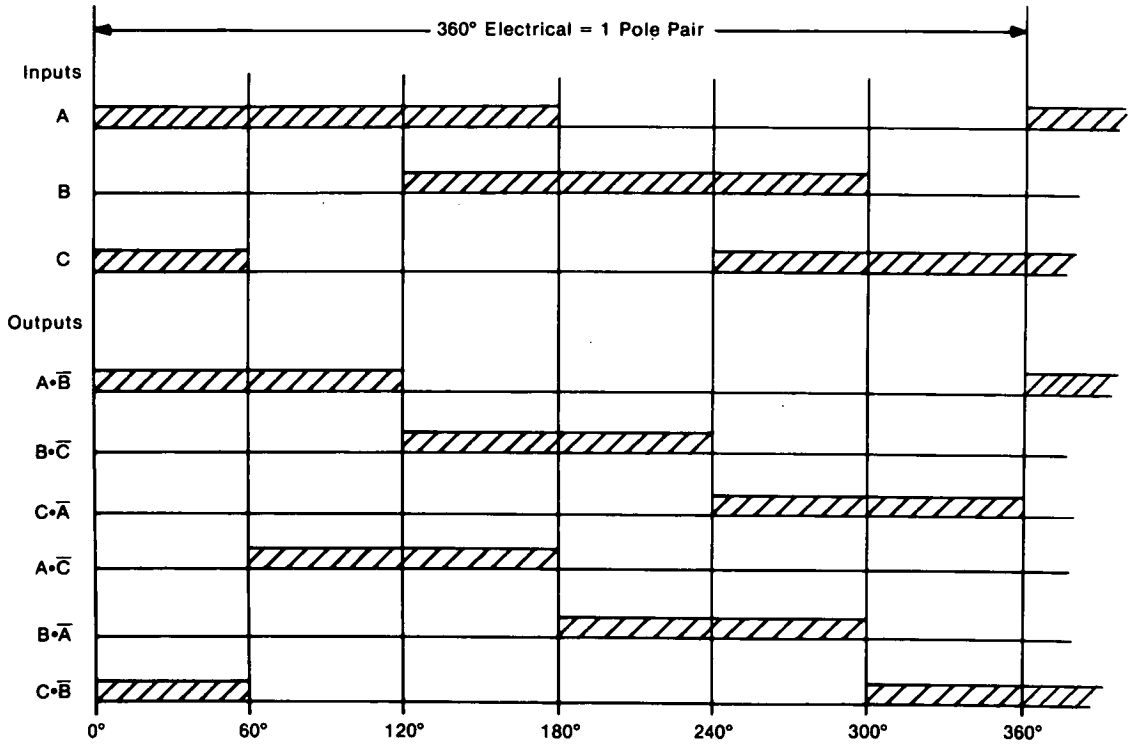

Figure 1. Timing Diagram for Three-Phase Full-Wave Decoder

(continued overleaf)

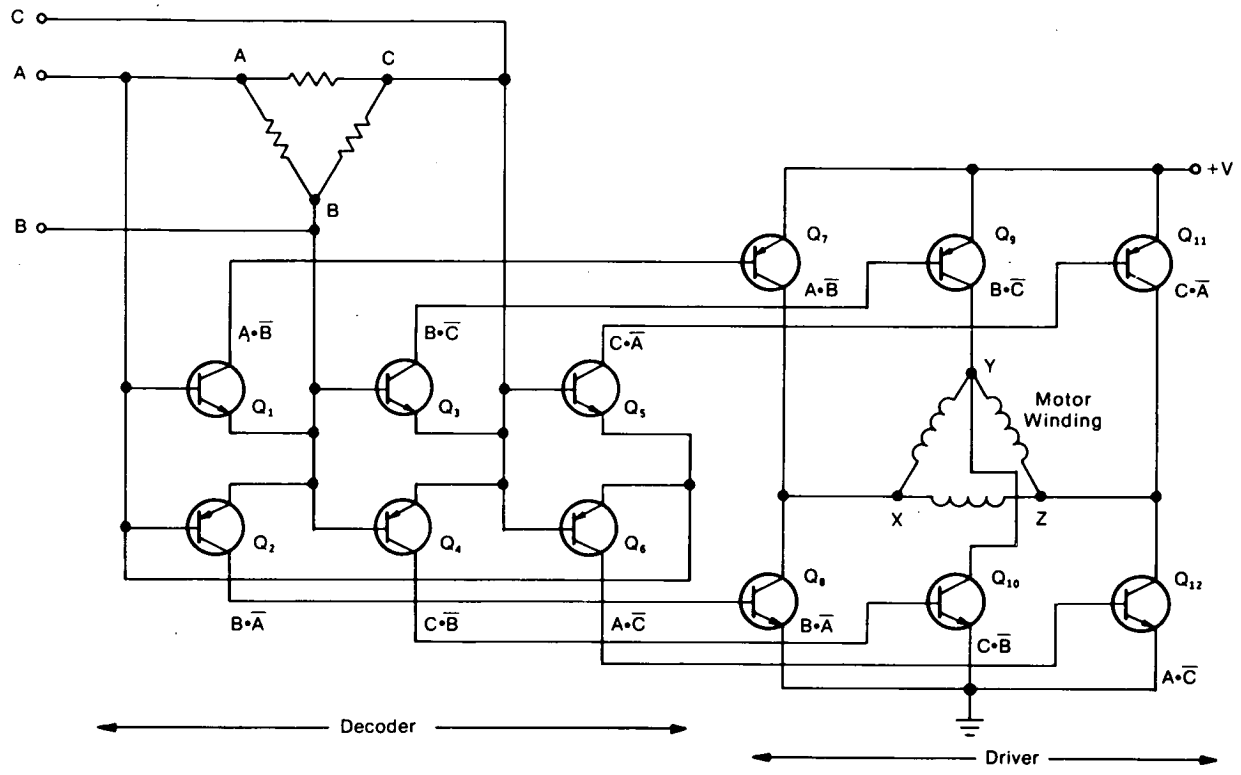

Figure 2. DC Motor Commutation

The switching sequence at one of the junction points of the motor is as follows: For example at point X, the potential rises to a positive value V at a zero-degree motor position and remains there for 120°. This potential then drops to a value between V and ground in the interval between 120° and 180°. Between 180° and 300°, the potential drops to ground level after which it rises again to the intermediate level between 300° and 360°. The cycle then repeats.

This type of decoding can also be obtained by using six optoisolators instead of the transistors Q_1 through Q_6. Each diode is enclosed in a package with a phototransistor. The phototransistors drive the transistors used in the power-switching bridge. The switching logic of this circuit is identical to the one explained.

Note:

Requests for further information may be directed to:

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Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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